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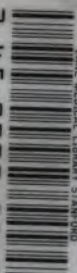
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RADIUM BIBLIOGRAPHY AND ABSTRACTS

TO Dr. R. L. Higdon,

ADDRESS 291 Geary St., San Francisco, Calif.

DATE MAILED 5/28/23

UNITED STATES RADIUM CORPORATION, NEW YORK

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FOREWORD

In the preparation of this supplement the director who supervised the compilation of the first edition aimed to carry out the same arrangement here.

Due to the fact that the number of Articles published during 1922 was small, we have combined the bibliography and abstracts in one volume, dividing it into two parts with each part indexed separately.

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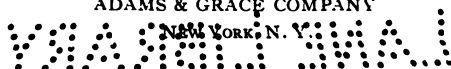
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Radium

PART 2
ABSTRACTS
SUPPLEMENT

No. 1

SECTION I

RADIUM—ITS PHYSICS, BIOLOGY AND GENERAL THERAPEUTICS

Curietherapy and Radio-Active Injections.

A. Jentzer, J. de radiol. et d'électrol., Paris, 6: 222, May, 1922.

Radium therapy is passing through a stage of evolution. The technique depends on the law of the square of the distance. The desideratum is maximum effect without injury. Plates and needles have proved useful in sarcoma.

The technique of radio-active injections has not been fully perfected. Solutions of the emanation in vaselin are unsuitable, since the vaselin acts as a foreign body, is not absorbed by the tissues, and produces the condition known as vaselin, or paraffin, tumor. Vegetable oils are absorbed, and form no tumors.

Since December, 1920, the writer has treated two inoperable cancers of the stomach, three goiters, three breast cancers and metastatic cancer of both ovaries, with subcutaneous injections of radium emanation dissolved in olive oil. The injections, each of 5 to 7 c. c., and 10 to 15 millicuries, were made once every two months. The tumor is injected in this manner in 5 or 6 different places. Of the patients with gastric cancers, one died, the other is much improved. Radium was also used internally in both cases, by a swallowed cupule, as in Einhorn's thread method. No histologic changes were found in the fatal case, but their absence does not show that the radium was ineffective. Of the goiter cases, one, of advanced sarcomatous goiter, died of bronchopneumonia. In the other two, epithelial and parenchymatous, the goiters have become smaller and pressure signs have almost disappeared. Of the breast cancer cases, one died following metastasis. The injections appeared to arrest progress and relieve pain. In order to prevent subclavicular or axillary metastasis, 1 c. c. of the radio-active oil was injected into these regions. The hard centers of the tumors could not retain the injection, and radio-active plates, yielding a dosage of 30 to 40 millicuries, were placed on the breast for 24 hours. The two surviving cases have each received 4 injections and are considerably improved. In one case, pain is relieved, the patient sleeps well and has gained 4 kg. in weight. The ovarian metastatic case was derived from cancer of the pylorus. Four injections have been made in the abdominal skin near the tumors, at intervals of 6 weeks. In 4 months the tumors have become much smaller,

the general condition is improved and the abdominal pains have almost completely ceased.

The Value of Interstitial Radiation.

D. Quick, Am. J. Roentgenol., 9:161, March, 1922.

The writer reviews advances and improvements in the methods of using radium salts, and discusses their disadvantages as compared with the new technique by which it is possible to bury small tubes of radium emanation interstitially and leave them permanently in place. Early experiments resulted in too severe reactions, but a practical working standard has now been reached.

The emanation is collected in fine glass capillary tubes, 0.3x3 mm., each containing 0.5—2 mc. emanation; 1 mc. per tube is the most generally useful amount. In large tumors stronger tubes, and in the small lesions, or near blood-vessels, weaker tubes should be used. The tube is inserted to the desired depth by means of a needle and trocar. One mc. radium buried interstitially and left in place gives a total radiation equivalent to 132 mc. hours, the radiation being continuous over many days. The danger from trauma is very slight. Necrosis about the tube is confined to a zone about 5 mm. wide, irrespective of the amount of emanation. Beyond the necrotic zone the tumor cells show marked degenerative changes, areas of necrosis, hypertrophy of cells, and hydropic degeneration with hyperchromatism of cell nuclei. Lymphocytic infiltration is marked, suggesting that radium while destructive also stimulates the natural defenses of the body. Care must be taken in introducing the tubes to obtain an equal distribution and to keep to the periphery of the growth, which is the actively growing and infiltrating portion; they should not be introduced through an infecting ulcerated surface unless drainage is free, and may often with advantage be implanted in the healthy tissue at the base of the neoplasm.

In all cases in which radium treatment is applicable emanation is to be preferred. In certain areas of the body the method has completely revolutionized treatment. In intra-oral work, for example, the results obtained at the Memorial Hospital have warranted the entire exclusion of surgery. In other areas buried emanations in conjunction with surgery offer great possibilities.

Fundamental Principles and Technic of Radium Therapy.

M. Felauer-Sklodowska, Polska gaz. lek., Warsaw, 1:68, 88, 112, 1922.

In radium therapy either radium element or its emanation is employed. Both constantly emit the so-called alpha rays, which, however, are too soft to be of therapeutic value. Only beta and gamma rays have an active effect; neither are uniform in velocity and in power of penetration. A scale of hardness is recognized in these rays, the soft rays being absorbed at the surface while the hard rays penetrate to deep tissues. Through adequate filtration, rays of different hardness can be applied. The thicker the filter, the more rays it will absorb.

Platinum makes the best filters, but other metals, as lead, silver, gold and brass, are used. As soft secondary injurious rays are produced by passing through metals, the metallic filters have been covered, for absorptive purposes, with materials of low density, as aluminum, gutta-percha, wax, gauze, paper. The soft beta and gamma rays are held back by 0.6 mm. platinum; a filter 1 mm. thick will hold back some hard gamma rays, and a filter 1.5 mm. thick will let only the hardest gamma rays pass.

Soft rays have a general destructive action upon tissues, while hard rays (principally the hardest gamma rays) have a selective action, that is, they destroy only cells in a certain stage of development. In the main, the destructive action of gamma rays is directed against cells of malignant tumors. In radium therapy, the hard gamma rays are used to destroy tumor tissue when the avoidance of superficial destruction and uniform irradiation are desired. Soft rays can be applied when tumor tissue alone is irradiated. Beta and gamma rays if applied in too small a dose or for too short a time, have an irritating action upon cells.

One of the principal difficulties in therapeutic irradiation is dependent on the physical law that the intensity of light is in inverse proportion to the square of the distance. In tumors of great thickness, the superficial cells being closer to the source of radiant energy, receive disproportionally greater doses than the cells of the deeper layers. Various measures have been devised to overcome this difficulty, but they are not uniformly effective.

Gamma rays (which penetrate deeply but are emitted only in small quantities) are reserved for the treatment of circumscribed tumors readily accessible from without. As a dosimetric formula, the quotient of the radiation intensity by the duration of time is generally adopted, a milligram-hour constituting the unit. In France, the number of millicuries consumed in one hour is taken as the measure. The method of therapy used by Regaud in the Radium Institute of Paris is based on the irradiation of a tumor with the maximal dose in one sitting in the shortest period of time. Fractional radiation often causes more rapid growth of the tumor. The salts of radium as well as the emanation are employed. The salt is preserved in tubes of platinum or in needles of platinum. The platinum tubes are in gold cases to obtain more powerful filtration. The needles are thrust into the tissues, while the tubes are inserted within flat gutta-percha or wax disks.

In carcinoma of the cervix 3 topical applications are made into the vagina (if possible, also in the uterus), representing altogether 10 mg. radium; 2 applicators, in flat corks, are pressed on the lateral walls of the vagina by a spiral; the third is placed before the portio. Three other applicators are introduced into the uterus with the help of a little apparatus. The dose is 60-70 millicurie-hours. Involvement of the rectum or bladder and extensive infiltration in the lower pelvis contraindicate radium treatment. Carcinoma of the tongue is treated by radiopuncture and simultaneously a flat applicator in the submaxillary region. For new growths of other organs, the method must be modified according to the seat of the disease. Superficial tumors are treated by flat applicators, 0.5 cm. from the surface; larger and deeper tumors are treated by radiopuncture or with flat applicators of greater potency

at a distance from the surface. Carcinoma of the rectum is treated either with flat applicators or by radiopuncture, and carcinoma of the prostate by radio-puncture, after operation to gain accessibility. In bladder tumors, radium is introduced either through an incision or through the urethra. The action of radium is unparalleled in uterine myomas. Radium will never fail in uterine hemorrhages.

In Germany Kehrler gives a preliminary treatment of six hours in every case of uterine carcinoma; four days later he does a biopsy and determines by microscopic examination the changes produced in the diseased tissue. From this he calculates the resistance of the tumor. New growths which are refractory to radium are treated surgically. Kehrler ascertained that very large doses of radium (up to 26,000 mg. hr.) will cause complete sterilization of the cancerous infiltrations down to the bones. Unfortunately, such large doses produce severe necrosis of the rectum and of the bladder walls, with their fatal consequences.

SECTION III A

RADIUM IN GYNECOLOGY

Technic and Statistics in the Treatment of Carcinoma of the Uterus and Contiguous Organs with the Combined Use of Radium and X-Rays.

H. Schmitz, Am. J. Roentgenol., 9: 662, 1922.

The outstanding facts of the researches of Friedrich and Glasser on the determination of isodoses or equal intensity curves of radium capsules are given by the writer. American radium capsules have a different construction from those of Friedrich and Glasser; therefore, the writer, in order to determine the biologic unit of dose had first to determine the equal intensity curves of his own capsules and the time duration of the application of 50 mg. radium element. In this work he was associated with Huth. They chose the isodoses 60, 40, 20, 10 and 5, respectively 1, 2, 3, 4 and 5 cm. distant from the surface of the filter in the line vertical to the center of the longitudinal axis, and determined the time duration of an application of 50 mg. radium element at these different points to produce an epilation or erythema skin dose (ep. s. d.).

The practical application consists in drawing median longitudinal and transverse sections of the patient to be treated, made from actual measurements; from this the exact intensities of radium rays on any part of the pelvis may be determined, taking into consideration the time duration. The intensity of rays to produce an epilation skin dose has been arbitrarily put at 100, and represents the biologic standard or unit of radiation dose.

The object in treating cancer of the uterus with radiations is to degenerate or destroy all the cancer cells without permanent injury to the bladder and rectum. The mucosae of the posterior bladder and anterior rectal walls are 2-2.5 cm. from the cervical canal. The highest intensity they will stand without injury or destruction is 130%, and therefore the application of 50 mg. radium element cannot be extended

beyond 36 hours at 2 cm. and 48 hours at 2.5 cm. The area within which this lethal cancer dose is attained corresponds to isodose 40. Cancer cells beyond this ellipse are not destroyed and beyond isodose 20 are actually stimulated. It was at this point that the feasibility of combining radium therapy with x-rays was studied. As most pelvic cancers have invaded the regional lymph-nodes, usually 6 cm. distant from the cervical canal, all cancer cells cannot be reached with radium without irreparable injuries to normal tissues. The writer has used 2 types of transformers, with an output of 140 to 300 kv. respectively, and 2 methods of measuring intensities, the direct and indirect. These methods of determining radiation intensities have made it possible to solve the problem of a correct radiation therapy, and to state whether the diseased area is traversed by a practically homogeneous radiation. Should the combined intensities at either the bladder and rectal wall or on the skin amount to more than 130 in patients with an anteroposterior diameter of less than 20 cm., the application time of the gamma rays or x-rays or both must be reduced; should they be less than 100 in patients with an anteroposterior diameter of more than 24 cm., the application of either gamma rays or x-rays or both must be increased. The writer has employed the method with 140 kv. x-rays and radium since 1919, but with 200 kv. x-rays only since November, 1921, too short a time to test the results of the newer method.

The total number of cases of cancers of the female urogenital organs treated between 1914 and 1921 inclusive is 423, divided among the vulva, urethra, bladder, vagina, cervix, corpus and ovaries. No cases were refused, but experience showed that clearly localized and borderline carcinomas offered a much better prognosis to radiation therapy than the clearly inoperable, recurrent and advanced cases. If only the operable and borderline cases of all the locations are considered, there were 25 cases with 12 absolute recoveries, or 48%. Considering only the cervical cancers there were 109 cases with 12 five year cures, or 11.1 per cent.

The localized and borderline cervix cases with a 5 year cure were 42.8 per cent., or 14 with 6 survivors.

Curietherapy in Hemorrhagic Metritis.

H. Cesbron, J. de chir., Par., 19: 594, June, 1922.

Radium has clearly an effect upon the hemorrhagic forms of metritis. A uniform dosage notation should be adopted. Expression in the number of millicuries of emanation destroyed is most logical and simple. The estimates may be based on the fact that 0.00751 millicuries, or 7.5 microcuries, of the emanation are destroyed per hour for 1 mg. radium element. Thus, a tube containing 25 mg. radium element will yield 187.7 microcuries per hour, and 4.50 millicuries in 24 hours, of destroyed emanation. If speaking of radium element, one millicurie destroyed is equivalent to 132 millicurie-hours, or 132 milligram-hours. If speaking of crystallized radium bromid, 1 millicurie destroyed is equivalent to 250 milligram-hours.

For uterine use, a series of platinum containers, linked end to end in a flexible, jointed chain, are used. Each link, 22 mm. long, contains radium salt or emanation. Its wall is 1 mm. thick. Each link

contains 6.66 mg. radium element, corresponding to 12.45 mg. hydrated radium bromid, and yields, in 24 hours, 50 microcurie-hours, or 1.20 millicuries, destroyed. If emanation is employed, each container should yield 6-10 millicuries, according to conditions and the length of the cervical canal, which determines the length of the chain or number of active links employed. Each platinum link is contained in an aluminum tube 0.03 or 0.04 mm. thick, in order to absorb the soft secondary rays emitted by the platinum. The entire chain is contained in a pure rubber tube 2 mm. thick, or in a rubber catheter. A special resin-silk tube is best. The entire length of the uterine canal should be occupied by the rubber tube. The superfluous end is cut away and the tube plugged, and a ligature attached to permit easy removal.

For vaginal use, a platinum container 2 mm. thick, or platinum-plated gold 2.5 mm. thick, may be used, enclosing 13.33 mg. radium element (24.90 mg. hydrated radium bromid) and yielding, in 24 hours, 100 microcurie-hours or 2.40 millicuries destroyed. In place of this arrangement, 2 parallel containers each holding 6.66 mg. radium and enclosed in the same sheath, may be employed. The platinum is surrounded by aluminum and the container placed within a cork filter 5 mm. thick, which may be made by boring a cork stopper. The ends of the stopper are plugged with cork and the whole enveloped with paraffin, melted at 100 degrees. The vaginal cork containers may be grasped in a forceps, whose blade is covered with rubber tubing, and placed in the lateral vaginal cul-de-sac. The author deprecates abdominal treatment with radium. Vaginal application alone may be adopted for treating fibromas where intra-uterine usage is difficult, or in metritis where intra-uterine application might activate annexial infection. Anesthesia should not be used. It is not necessary to wrap the rubber tube in gauze, or to dilate the uterus extensively.

A single treatment is admissible for tumors, but small doses, repeated, are best for metritis. Penetration should be deep and soft rays filtered out. The thickness of bronze, lead and silver filters should vary with the density of the metal employed. There should be rigid asepsis. If there is a purulent discharge, an autovaccine should be prepared and injected during several days before radium treatment is begun. Intra-uterine application should not be made until a week later and then only if the symptoms have disappeared. If tumor is suspected tissue should be removed and examined.

Metritis in virgins should not be treated with radium until ergot, hamamelis, calcium chlorid and opotherapy have failed. The application should be intra-uterine only. Not more than 6.66 mg. radium element or 8 to 10 millicuries emanation should be used. For the first application of 12 hours the dose yielded per link should be 0.60 mcd. For a uterine canal 6 cm. long, 3 links, or a dose of 1.80 mcd., will hours' application may be made, each link yielding 0.90 mcd., or in the typical case, a total yield of 2.70 mcd. In persistent cases, a third, or 24 hours' application may be employed, yielding, in the typical case, a total of 3.60 mcd. This dose should rarely be exceeded. The menses disappear or diminish for 2 or 3 months, then become normal, and many young women, treated as described, have had normal pregnancies.

For the metritis of older women, which is obstinate and hemorrhagic, without fibroma or other anatomic cause, if hemorrhage is not immediately serious a 24 hours' application, intra-uterine only, may be made. Each link used yields 1.20 mcd. If hemorrhage is critical, a 48 hours' application, including a uterine dose of 7.20 mcd. and a vaginal dose of 9.60 mcd., or 4.80 mcd. for each of the 2 culs-de-sac, total dosage 17 millicuries destroyed, is indicated. Since 10 mcd. per ovary may produce an artificial menopause, the large dose employed for grave hemorrhage may possibly have that undesirable effect, but it has never occurred in the writer's experience.

For chronic and climacteric metritis, the writer uses a 48 hours' intra-uterine application, yielding 2.40 millicuries destroyed per link. In obstinate cases, a vaginal application of 3 or 4 days is added, the dose for each cul-de-sac being 7.20 to 9.60 mcd.

The writer agrees with Koenig's findings. Slight nausea, pain, malaise or uterine colic may appear during about a week. If an artificial menopause occurs, the usual symptoms appear, not increased by the treatment. Otherwise, the menses cease for 1 or 2 months, then become normal. The first menses following the treatment are sometimes abundant. A few cases fail, from some unknown cause. Success is 94 per cent. to 100 per cent. Radium cannot be satisfactorily replaced by the x-rays. Acute annexitis constitutes the only contraindication to the use of radium.

SECTION III B

CANCER OF THE BREAST

Treatment of Recurrent Inoperable Carcinoma of Breast by Radium and Roentgen Ray.

B. J. Lee, J. A. M. A., 79: 1574, 1922.

The writer says that all cases of carcinoma of the breast may be classified in one of five clinical groups: (1) primary operable; (2) primary inoperable; (3) recurrent operable; (4) recurrent inoperable, and (5) the prophylactic group, which comprises those patients who receive prophylactic irradiation following radical operation of the breast. The writer's observations presented herewith are based on a series of 218 cases of recurrent mammary cancer treated at the Memorial Hospital, most of them inoperable at the time of admission, and 94 so advanced as to be hopeless; of the others, 124 could be irradiated with a fair hope of some favorable result. He urges that a careful selection of patients for operative treatment be made as a prophylaxis against the recurrence of breast carcinoma.

The lesions most amenable to treatment by radium itself are small localized lesions in the infraclavicular region, or adherent to or involving the chest wall, small localized skin metastases or small accessible nodes. In a series of cases studied by the writer to estimate the value of postoperative irradiation as a factor in prolonging life, he observed that the length of life after recurrence in 22 patients on whom a radical

amputation had been performed, with no subsequent irradiation, averaged 6½ months. In the patients in the author's series, who were treated by irradiation following the appearance of recurrence, the length of life after recurrence has been 2 years and 4 months.

SECTION IV

RADIUM IN MALIGNANT DISEASE, CANCEROUS AND BENIGN GROWTHS

Treatment of Malignant Tumors with Radium Needles.

A. Heyerdahl, Acta Radiol., Stockholm, 1: 358, 1922.

The writer describes 4 clinical cases in corroboration of the favorable results obtained by the application of radium salt imbedded in small hollow needles, as recorded especially by American authorities. In this form, radium not only influences the tumor much more effectively than when it is applied on the outside, but is also much less injurious to the surrounding healthy tissue, provided the distance between the needles and the length of exposure are properly regulated. The needles were supplied by Armet de Lisle in Paris. They consisted of platinum iridium (length 17 mm., outside diameter 1.3 mm., thickness of walls 0.3 mm.) and contained each not quite 1 cg. radium or 0.46 cg. radium element.

The principal features of the four cases were as follows: Case I. Man, 65 years. Recurrence of labial cancer after operation. Outside application of radium proved inadequate to arrest the progress of the ulcerating tumor, which finally involved the whole lower lip and the greater part of the left chin. The application of 5 needles, 25 mm. apart, on two occasions separated by an interval of one month, so that the total exposure of the whole area around the ulcer amounted to 20 hours, produced excellent results within less than two months. Complete recovery is expected. Case II. Man, 63 years. This case is quite similar to the former, but less advanced. The insertion of 5 needles during 20 hours resulted in the complete disappearance of the growth. Case III. Female patient, 67 years. Recurrence of epithelioma on the left cheek after a temporary success achieved by outside application. The insertion of 2 needles in the ulceration caused it to heal completely with smooth cicatrization. Case IV. Man, 77 years. Tumor on the lower lip. After the application of 2 needles for 20 hours, all that was left of the tumor at the time of the last examination was an infiltration the size of a grain.

With the exception of the third case, the insertion of the needles was combined with outside application; but in the second case, this resulted in obstinate dermatitis. The writer states that it is too early to venture definite statements as to the permanency of the cures.

Two other cases are described in which a cure was apparently brought about by the insertion of radium tubes into the tumor: Case V. Woman, 55 years. She had had a recurrence of carcinoma on the

nose after operation. Case VI. Boy, 8 years. He had recurrence of sarcoma on the right cheek after operation.

The Treatment of Malignant Neoplasms with Radio-Active Substances.

R. Werner, Strahlentherapie, Berlin, 13: 500, Feb. 1, 1922.

The effect of the rays of radio-active substances is remarkably similar to that of Roentgen rays, the chief difference being due to the slight penetrating power of alpha and beta rays and to their considerably greater energy as compared to gamma rays. Different tissues vary in susceptibility to radio-active substances according to (1) their richness in cells, as interstitial substances are attacked much less than the parenchymatous, and (2) the capacity of the cells to multiply, the cells that undergo frequent division being more sensitive. There is besides this an indirect influence; the vascular endothelium is severely affected, and extravasation of white and red blood corpuscles, inflammations and hemorrhagic infiltrations may occur in the vicinity of the vessels and lead to obliteration of the vessel lumen. The tumors will then become smaller, more mobile, cicatricial; histologically they show vacuolar degeneration of tumor cells and proliferation of connective tissue; at times the central portions of the tumor soften and liquefy (a kind of cyst formation). When punctured the tumors collapse, but refill repeatedly; this is attended by danger of viable cells being washed out and forming metastasis. Besides, obstruction of the arteries may lead to death of the tissues. Excessive irradiations with their atypical sequels in the tumors weaken the body and may induce septic-like conditions with high temperature and tendency to cardiac weakness. For this reason exact dosage is necessary.

For most purposes the object is usually attained by external irradiation with an intensity of about 200 mg. radium element, unless it is distributed over too many and too weak substances. Deeper tumors require cross fire. Combination with roentgenotherapy is advantageous at times. In treatment of tumors with radium before operation, the stage of shrinking and relaxation should be awaited. It should be borne in mind that the healing of wounds is delayed and rendered difficult after intense irradiation with radium, so that irradiation before gastric and intestinal resection should be avoided. As a rule in those tumors which are rendered operable by radiotherapy, treatment with radium should be continued and an expectant course followed. Post-operative radium therapy is often indicated, especially where intracorporeal irradiation is applicable, for instance, in resection of the upper maxilla.

For intracranial tumors of anterior fossa, 3 or 4 fields (temple, forehead, vertex or nose) should be treated by external application of 200-250 mg. radium element in several applications covering a surface of 20 sq. cm., kept 5 cm. from the surface of the skin by pressed cork and gauze. In distributing the applicators care should be taken to obtain as homogeneous a field at the skin surface as possible and to attain the erythema dose in twenty-four or twenty-six hours. In tumors of the cranial bone a bundle of tubes (usually 2 or 3 with a total inten-

sity of 90-150 mg. radium element) is introduced into the nasopharynx and a tampon is applied. Irradiation lasts about eight or twelve hours. For tumors of the posterior cranial fossa, 3 fields, and for tumors of the middle fossa 2 fields should be employed.

Gliomas and gliosarcomas generally react favorably, pineal gland tumors very favorably. Teratomas and cysts are unsuitable. A number of retro-bulbar tumors have been cured by radium. If only gamma rays come into action, and if a certain homogeneity can be obtained by proper distancing, a lesion of the optic apparatus and optic nerve need not usually be feared. Tumors of the upper maxilla are not very favorable for pure radiotherapy, but 2 fields may be irradiated; as a rule it is better to operate first. Recurring tumors are generally better than primary ones, probably owing to more favorable irradiation possibilities.

For hypopharyngeal tumors direct irradiation after tracheotomy or external irradiation over 2 fields is practiced. Tonsil tumors are usually irradiated directly and react well; they may first be enucleated and irradiated afterward. Tumors of the buccal mucous membrane are extraordinarily resistant, though technically suited to irradiation, as well as the slightly radiosensitive carcinomas of the floor of the mouth and tongue. In these tumors operation should precede irradiation.

In laryngeal carcinomas radiotherapy gives better results than operation if the tumors are situated above the vocal cords, but in those lying below the vocal cords or in the cords themselves, total or semi-total laryngectomy followed by prophylactic irradiation (external, 2 fields) gives better results. In malignant struma, radium therapy has often proved successful with 2 or 3 fields, or possibly 1 field, on the neck. Cures for several years have been observed. There is no danger of thyroidism. Glandular tumors on the neck are often favorable, also lymphosarcomas, other sarcomas and bronchial carcinomas. Substernal and mediastinal tumors are more suitable for x-rays owing to their deep situation. Esophageal carcinomas which show prolonged clinical healing only in isolated cases, may be treated by insertion of a tube with 30-50 mg. radium element through the esophagoscope. There is danger of necrosis, infection and perforation.

Radium is superior to x-rays in mammary carcinoma when cross-fire irradiation is inapplicable, but success is uncertain and operation should be performed first. No considerable success is possible by external radium irradiation in intra-abdominal tumors, and only isolated metastases or primary tumors of the abdominal wall disappear. Irradiation (internally through intestinal fistulas) of carcinomas of the gastric tract has been attempted but the strong sensitivity of the intestinal mucosa is a draw-back. In rectal carcinoma the results are only palliative, permanent cures being extremely rare. Transitory success was observed in bladder carcinoma, in which, sometimes, pain disappears and hemorrhages and tenesmus cease.

Tumors of the extremities are suitable for radium therapy. The most favorable field for radium is skin epithelioma; in 70 per cent. of cases cure has persisted three years with good cosmetic effect. Operation is indicated only in refractory cases.

SECTION V

RADIUM IN DERMATOLOGY

Curietherapy in Spindle Cell Epithelioma of the Skin.

Parès, Arch. d'électric. méd. etc., Bordeaux, 30: 261, 1922.

Many cures of spindle cell epithelioma of the skin are being reported. The writer inserts needles into the tumor, the dosage of each being 10 microcurie-hours and the needles being left in place for 10-15 days. The tumor is also enclosed in a lead box, molded to fit its outline and containing tubes each holding 25 mg. radium bromid and enclosed in 1.5 mm. platinum. The lead box is lined with aluminum to arrest secondary rays, and with gauze which acts as a filter and permits suitable adjustment of the box to the skin. The box and tubes are applied in 3 or 4 periods, each of 24 hours and separated by 2 or 3 days' intervals.

Twenty-two cases of tumors, reported by the pathologist as spindle cell epitheliomas, have received this treatment. No mixed tumor forms are included. Eight cases were cured, the failures numbering fourteen. The appearance of ulceration, and adenopathy, constitute unfavorable signs. The presence of spindle cell epithelioma is not in itself sufficient for prognosis, the blood-count and condition of the vessels and connective tissue being also important.

SECTION VI A

OPHTHALMOLOGY

Report of Case of Epithelioma of the Cornea.

D. Y. Keith & J. P. Keith, Am. J. Roentgenol., 9:337, June, 1922.

The patient, a man of 64 years, had a redness in his left eye for several days, and as the redness disappeared his vision gradually failed. At the end of 60 days he could see only from the outer lower segment of the left eye; a month later the eye had a milky color. When seen by the writers the entire cornea was of a milky white or limestone color, much denser over the inner and upper half; the extreme lower outer quadrant near the limbus was of a much fainter density. The new growth was limited to the cornea. Patient could not recognize a bright light except when it was on the floor or beneath the eye. The diagnosis of epithelioma of the cornea was made. After cocaineization a self-retaining lid retractor was inserted and an application of 50 mg. unfiltered radium applied to the nasal and temporal half of the left eye at a distance of 1 cm. A total of 42 mg.-hr., however, was applied to each side of the eye, distributed in four gold needles of about 12½ mg. radium element each, with no attempt to protect the lids. The radium reaction on the cornea was hardly perceptible and was at its height at the end of the third week; in 6 weeks the limestone color had disappeared, and when seen at the end of 5 months sight was completely restored; 9 months later there was no recurrence. This case seems to indicate that the cornea is more resistant to radium rays than the surrounding structures.

The cases of corneal epithelioma are very rare, only 13 being found in the literature. A review of these indicates that the application of radium to tumors of the cornea or bulbar conjunctiva far excels operative procedure.

SECTION VI B

OTO-RHINO-LARYNGOLOGY

Cancer of the Palate and Soft Palate (Lobular Epithelioma) Cured by One Application of Radium.

P. M. Constantin & G. Dupeyrac, Bull. d'oto-rhino-laryngol., Paris, 1: 15, 1922.

The growth occupied the posterior half of the palate and extended into the soft palate to within 5 mm. of the base of the uvula. After a long antisyphilitic treatment (instituted because of a positive Wassermann) the patient, a man aged 62 years, consulted the writers because of the unsuccessful therapeutic treatment. On histologic examination the diagnosis of lobulated epithelioma with numerous epidermic globes was made. The lesion was practically inoperable and the patient did not want any surgical intervention. Radium seemed to offer some chance of success.

The patient, very nervous, had incoercible reflexes, in spite of local anesthesia with novocainadrenalin, and very abundant salivation and expectoration. To render possible the fixation of the radium tube, general anesthesia with kelene was employed. The radium was enclosed in a platinum tube, 5 mm. thick and a silver tube 1 mm. thick. The metallic tubes were placed in a supplementary hard rubber tube 1 mm. thick. The tube was fixed by 2 sutures, one in the neighborhood of the uvula and the other at the median-posterior part of the palatine vault. At the end of twenty-four hours the patient, who had been able to sleep part of the night without morphin, was relieved of the embarrassing apparatus, which had been very well tolerated without much suffering. There was considerable edema of the uvula and soft palate, slight edema of the pillars and at the site of the sutures. This edema disappeared in twenty-four hours. Soon after the suppression of the radium, the patient, who was very thirsty, was able to drink and take nourishment without embarrassment. The neoplastic ulceration was soon covered with a whitish eschar, remained stationary for twenty days and then commenced to diminish by retraction of its borders. Thirty-five days after the application of the radium, the transformation was produced and there no longer remained a trace of the epithelioma.

Radium Therapy of Cancer of the Mouth and Throat.

C. E. Field, New York State J. Med., 22: 121, March, 1922.

When cancer masses are to be removed, they should be first radiated with radium or x-rays, and excised by electric coagulation or surgery. When retrogression of the mass is desired, the procedure should be radium; if bone or deep tissue is to be removed, surgery.

A prophylactic or preoperative radiation which causes a sclerosis of the lymphatic glands and vessels and thereby checks metastasis usually consists of about 3000 milligram-hours. Radium element, 300 mg. with 1.5 mm. of brass and 2 cm. of felt or other distance screen, is allowed to remain bandaged to the glands of the neck for ten hours. Two weeks later, while the inhibitory influence is at its height, the operation may take place. Such precautions of treatment are advocated for the chain glands of the neck when attacking any malignant nodule or ulcer within the mouth or throat.

Epithelioma of the lip may be treated with dosage varying from 50 to 100 mg. screened with 0.5 to 1 mm. of metal and 2 to 4 mm. soft rubber from thirty minutes to two hours, in fairly light areas of infiltration. Where nodular masses are present, they are best treated by inserting platinum-iridium needles loaded with radium element; 10 mg. per cubic centimeter of tissue for a period of three hours is a very effective dose. Epithelioma of the tongue, tonsils and pillars should be treated by radium needles but where such method cannot be adopted, tubes of radium suspended in metal clasps, dental compound, or special applicators are applied to the malignant nodule. Malignant tumors of the epiglottis, the false and true cords, are best treated by radium needles, plunged into the masses through the aid of a long armed alligator forcep worked through the direct laryngoscope. A sharp cross-fire through the neck of 300 mg. for seven hours should be advocated when the needles are used within the larynx. At times it is possible to insert a hard rubber capsule within the lumen of a rubber breathing tube and force it into the larynx.

Statistics and Technic in the Treatment of Malignant Neoplasms of the Larynx.

D. Quick & F. M. Johnson, Am. J. Roentgenol., 9: 599, Sept., 1922.

In applying radium to a laryngeal growth certain difficulties arise which are not met with in other parts of the body. If applied effectually it creates a sharp inflammatory reaction of several weeks' duration; it often interferes with both swallowing and breathing. Hence the danger of impairment of the patient's general health, usually already undermined. Also in bulky extrinsic growth sloughing and hemorrhage must be looked for. Radium must be regarded as a new instrument with the technic of its application in the making. The writers believe that every case accepted for treatment should receive intensive radiation by heavily filtered radium applied over both sides of the neck and directed toward the primary growth. They have employed filtration of 2 mm. brass and dose ranging from 2200 mc. hr. at 3 cm. distance to 9000 mc. hr. at 6 cm. distance; or efficient x-radiation should be used as a second choice. For internal treatment the greatest advance has been through the introduction of radium emanation tubes directly into the growth. These are fine capillary glass-tubes approximately 0.3 x 3 mm. in size, containing radium emanation. This emanation decreases in value at the rate of approximately 15% per day. One mc. radium emanation buried interstitially and left in situ until exhausted gives a dosage of 132 mc. hr. The emanation in this form is entirely unfiltered except for the thin wall of the glass tube, which removes little

more than the alpha rays. Hence the full effect of both beta and gamma rays is obtained, and since the radiation is extended over several days, a larger dose can be given. Trouble has never resulted from the glass emanation tubes as foreign bodies. They are either expelled and expectorated or are encysted in scar tissue. Apart from the problem of beta radiation obtained, these emanation tubes for laryngeal work have a very definite advantage over needles containing radium salt in that they are smaller, cause less trauma, and cannot be dislodged as a needle with a string at the end might. Also the whole procedure is over at one sitting and there is nothing left to be removed later.

For a certain limited group of localized, relatively superficial intrinsic growths a small glass bulb 6-8 mm. in diameter is used, containing 500-600 mc. emanation and mounted in a protecting metal cone with paraffin. The cone is open at its base and to the apex a long flexible wire is attached. This permits of holding accurately in place by the indirect method a very large quantity of unfiltered radium emanation for a time long enough to give an intensive dose. A few minutes is sufficient, and besides accurate localization the surrounding normal tissues are protected from injury.

As a result of such treatment of a series of 156 cases at the Memorial Hospital during the past 5 years certain conclusions may be formulated: (1) While radium offers hope to a larger number of cancers of the larynx than the older methods, its use is experimental as yet. (2) The evidence to date does not warrant radium treatment of primary operable intrinsic cancer of the larynx. (3) It is suggested that pre-operative use of radium in operable cases would aid materially. (4) The radical use of intensive radiation is permissible in cases offering a reasonable hope of complete recovery. (5) Radium should be withheld in the very advanced cases.

Radiotherapy in Carcinoma of the Larynx with Special Reference to Radium Needles through the Thyrohyoid Membrane.

G. E. Pfahler, J. Radiol., 3: 511, Dec., 1922.

This form of cancer is usually discovered early enough to yield to radium. The great difficulty lies in applying it accurately. Radium accomplishes best results when it can be applied directly in the tumor tissue. Four methods are described of doing this by emanation seeds or radium needles, the last of which is the subject of this paper—inserting radium element needles through the thyrohyoid membrane into the diseased tissue on one or both sides.

Tracheotomy should be done before introducing the radium needles; otherwise the edema and congestion from the radium application might lead to strangulation or at least to hasty and inconvenient tracheotomy. If there is not much stenosis tracheotomy may be delayed until the preliminary x-ray treatment has been given, the object of which is to devitalize partially the primary cancer cells and any metastatic lymph-nodes present, thus making the puncture of the neoplasm less dangerous. This requires 1 to 2 weeks, and may be continued until the tumor tissue no longer decreases. The patient will probably be ready for the introduction of radium about a week after tracheotomy. The needles

should be thoroughly sterilized and attached to sterile thread or copper ligature wire.

The patient is given a general anesthetic, and the skin is thoroughly cleansed by alcohol. The needles can be confined in this treatment to the affected side; if both sides are involved the needles can be inserted on both sides. The larynx is crowded as far as possible toward the affected side. If the disease extends downward the needles are introduced as nearly vertically and as nearly confined to the central portion of the disease as possible; 10 mg. needles can be inserted about 1 cm. apart and left in place 4-6 hours, causing considerable reaction and probably edema, but if the patient already has a tracheotomy tube in place there is little discomfort. If the disease has not entirely disappeared at the end of 6 weeks the treatment may be repeated. Within 2 or 3 weeks after the introduction of the radium needles, if any metastatic lymphnodes are present, the radium needles may be introduced into them and x-ray treatment applied over the general area of the neck involved.

The writer then describes in detail a number of cases in which this treatment was used with striking success, and states that unless the patient is treated very early and before there are obstructive symptoms it is desirable to do tracheotomy before raying; that x-rays alone applied externally may produce even in advanced cases temporary recovery; that the insertion of radium needles through the thyrohyoid membrane into the diseased tissue is practical and the results justify further trial. The patients should be kept under close observation for several years as there is a marked tendency to recurrence.

SECTION VII

RADIUM—ITS EFFECT UPON THE BLOOD AND USE IN BLOOD DISEASES

Radium in the Treatment of Myelogenous Leukemia.

A. Henriques & L. J. Menville, New Orleans M. & S. J., 75: 247, 1922.

An enormous spleen, extending almost to the right lateral abdominal wall and to the symphysis pubis and protruding markedly toward the front and the left, was so reduced in size that it could not be palpated 15 months after treatment was started. The white cells have shown a progressive decrease to about 20,000; the writers hesitated to reduce them further, for fear of producing a leukopenia. The myelocytes have shown a marked reduction. The red cells increased from about 2,000,000 to above 5,000,000 in a little over 90 days. This occurred in two cases.

In a third case, where no red count had been made at the beginning of treatment, the red cells at the end of 17 months numbered 5,400,000. The hemoglobin also showed a marked rise. These results were accomplished by a dosage of 2200-2400 mg. hr. spread over 4 areas near the center of the spleen, through the skin, repeated monthly.

The central portion of the enlarged spleen was treated. It was desired to secure an effect upon the spleen itself, aside from the action upon the blood as it entered the spleen. It is accepted that the principal effect of radium does not extend more than 6 cm. from the point of application. As a result of one series of applications, the enormous spleen contracted 4-5 inches (10-12.5 cm.) from right to left, and showed a marked reduction in other dimensions. After the monthly applications, the spleen continued to shrink so that it is no longer palpable. The dosage employed was 550-600 mg. hr. over each of 4 areas, a total of 2200-2400 mg. hr. The areas treated were 1 inch square, the radium was elevated $\frac{3}{4}$ inch above the skin, and the rays were filtered through 2 mm. lead. Four areas were used to avoid skin reactions. The tendency is for the disease to recur. On application of only one-half the dose, the white count increased somewhat at the end of 4 weeks, but this rise was followed by a decrease upon administering a full dose. If a case was not treated for two or more months the white count rose sharply. During the course of treatment there was a disappearance of metastatic nodules in both nipples of one patient, a male. The tendency to epistaxis was overcome—a fact of interest in connection with the work of Stephan in shortening the coagulation time of the blood by irradiating the spleen.

SECTION VIII

RADIUM IN THYROID AND GOITER

Radium Emanation in Exophthalmic Goiter—Blood Vessels of Adenomas of Thyroid.

W. I. Terry, J. A. M. A., 79: 1, July 1, 1922.

A total of thirty-three cases of exophthalmic goiter have been treated with radium emanations by the writer. Only patients suffering from an extreme degree of hyperthyroidism, due to hyperplasia of the thyroid, have been subjected to radium treatment. The technic used is very simple. A local anesthetic is used. Then the minute capillary tube containing the emanation is introduced into the gland by means of a small caliber, hollow needle, and is pushed into place by a plunger. Usually six emanation tubes, containing a total of from 6 to 10 millicuries, are inserted in the upper, middle and lower thirds of each lobe and through one skin puncture on each side. An effort is made to bury the tubes at least half a centimeter in the thyroid.

Final results have been obtained in sixteen of the thirty-three cases. Fourteen patients had resections of the thyroid after intervals varying from 32 to 114 days after radium. One patient died two days after a bilateral resection from acute hyperthyroidism. Another patient died nine months after resection of both lobes from recurring hyperplasia of the thyroid and marked hyperplasia of the thymus and a terminal pneumonia. A third patient died three months after radium from cirrhosis of the liver. A fourth patient died fifteen days after bilateral resection of the thyroid, from acute yellow atrophy of the liver. Ten patients are definitely cured after resection.

In two cases there has been an apparent cure by radium alone. In one the basal metabolic rate was 122 per cent. plus before the introduction of eight tubes, containing 5.6 millicuries of radium emanations. Four months after radium his basal metabolic rate was 12.9 per cent. plus. The other patient had a basal metabolic rate of 84.4 per cent. plus before five tubes, containing 6.7 millicuries, of radium emanations were given. Four months after radium his basal metabolic rate was 5.7 per cent. plus. He is now working as a stevedore and teamster, and seems entirely recovered.

The writer has not used radium emanations in the treatment of simple colloid goiters or for adenomatous goiters. In fact, he believes radium to be contraindicated in adenomatous goiters. The emanations are, however, of value in preparing bad risk cases of exophthalmic goiter for further surgical treatment.

SECTION IX

RADIUM IN UROLOGY AND DISEASES OF THE GENITO-URINARY TRACT

Technic and Statistics in the Treatment of Carcinoma of the Bladder by Radium.

B. S. Barringer, Am. J. Roentgenol., 9:757, 1922.

By means of a flexible spring holder used through the sheath of the Brown-Bürger operative cystoscope, 100 or more millicuries un-screened radium may be held for 30 minutes against an intravesical tumor while it is being observed through the cystoscope, and this operation may be repeated every 2 weeks, or less often if the tumor is disappearing satisfactorily. If it looks hard or solid or has an indurated base, a radium needle screened simply by the steel of the needle may be thrust into the base or indurated part; 50-200 mc. radium may be used up to 40 minutes. Similarly, small bare tubes of radium may be implanted into the base of a tumor and left there, using tubes of 0.7-0.8 mc. to 1 sq.cm. of tumor. In both these cases the action is local and caustic. Of all methods the latter has proved most satisfactory.

For suprapubic application of radium in extensive carcinoma, gas and oxygen anesthesia is used. The bladder is washed and filled with a 1:4000 acriflavine solution and the patient placed in the Trendelenburg position. The skin incision extends from the symphysis to the umbilicus; the prevesical fascia is cut transversely at the symphysis and dissected back, the bladder being exposed well down its posterior wall. The urachus is cut and the exposure extends beyond this. The bladder is gently palpated so that the incision may not go through the tumor tissue. The bladder is opened longitudinally by a 3-4 inch incision, the cut surface grasped by clamps about 1 inch apart to prevent its collapsing and falling down into the pelvis when retractors are inserted. A light is thrown into the bladder and 3 or 4 retractors made of one-eighth inch steel wire loops are gently placed within it, allowing the tumor to be seen through the loops. The exposed tumor is lightly sponged to prevent bleeding and spreading of cells, and protruding por-

tions are snared off. Indurated parts of the tumor are implanted with radium bare tubes (0.7 mc., 1 to the sq. cm.) inserted into the extreme edge of the tumor. The bladder is then filled with 60 per cent. alcohol for 3 minutes to kill stray tumor cells and prevent implantation; it is then closed up with plain catgut and usually drained by a small rubber tube.

In 8 of 10 cases of small operative carcinoma (80 per cent.), the tumor has been removed from the bladder by radium. The two patients who died lived 2 years and 3 months respectively after they were first seen. In 20 inoperable cases of bladder carcinoma the tumor has also been removed from the bladder by radium (proved by cystoscope). There have been 3 recurrences, and 1 death from radium slough of the bladder. It is felt that radium removal is superior to surgical, because it can cope with inoperable cases. If a suprapubic radium removal is necessary the time of operation is shorter and the kidneys are less disturbed by the operation; postoperative or postradium recurrences can be better dealt with; many so-called operable tumors can be removed intraurethrally without any operation.

Radium in Cancer of the Prostate.

H. C. Bumpus, Jr., J. A. M. A., 78: 1374, May 6, 1922.

The Mayo Clinic has records of 729 patients with carcinoma of the prostate, 217 of whom were treated with radium, a number sufficiently large to afford valuable statistical data, while the patients who were not so treated furnish a record of the normal course of the disease, thus making a basis on which to compare results.

Before treating patients with carcinoma of the prostate with radium, or judging the results of such treatment, metastasis must be excluded. The detection of metastasis in 28% of all patients examined reduces materially the indications for radium treatment. As 73% of 113 patients with metastasis examined at the Mayo Clinic died during the ensuing year and average length of life after examination was seven months, it does not seem justifiable to treat a patient with radium simply for the local effect obtained on the original growth.

The writer divides the 217 patients treated with radium into 3 groups: (1) Patients treated by rectum and by urethra; (2) Those treated by needles inserted directly into the growth through the perineum, and (3) Those treated by a combination of the two methods.

In the first group, the amount of radium given has varied, since the treatments were given in the earliest cases. The rectal and urethral applications were alternated. The rectal dose averaged 1,482 mg. hours, and the urethral 217. Fifty patients were treated by this method and completed records have been obtained from forty. They lived an average of seventeen months after treatment and an average of forty-five months after the onset of symptoms.

In the second group, thirty-seven patients were treated by inserting needles directly into the gland through the perineum. The average dose was approximately 2,000 mg. hours. Completed records of twenty-seven patients show that they lived an average of fourteen months after treatment and that the duration of the disease from the onset was

forty-five months, slightly longer than the average for patients not treated.

On the supposition that the poor results obtained from the use of rectal and urethral exposures alone, or from the use of needles alone, were attributable to the fact that not all of the cancer cells were reached by the radium emanations, the remaining 127 patients were treated by a combination of the three methods. Completed records of 83 patients show that the average dose of radium was 1,960.45 mg. hours. Sixty patients are dead; they lived an average of eleven and twenty-five hundredths months after treatment; 66 per cent. died the first year. The duration of the disease in the patients who died is approximately the duration of the disease in the patients who were untreated. Twenty-three are alive, the duration of the disease having increased to forty-seven and thirty-three hundredths months, and the time since their last treatment to twenty months, as an extension approximately of one year in each.

Since only eight of the 217 patients treated with radium are alive after three years, it will be seen that the results are far from satisfactory. The fact that 27 per cent. of the living patients are now in their third year after treatment, and a number do not show evidence of malignancy, while only 8 per cent. of untreated patients survive to their third year, prevents the abandonment of this form of therapy.

Radium therapy should be applied in less than one-half of the patients with carcinoma of the prostate. One-third of all patients with carcinoma of the prostate will be found to have metastasis at the primary examination. Complete and thorough irradiation of all portions of the neoplasm with minimal doses applied from many locations affords better results than maximal doses applied from a few locations. Prolongation of life can be expected in only one-fourth of the patients treated.

SECTION X

RADIUM—ITS UNUSUAL USES

RARE CASES—GOUT AND RHEUMATISM—BRAIN, ETC.

Radium as a Curative Agent for Tuberculous Glands.

E. S. Molyneux, Lancet, 2:804, Oct. 14, 1922.

The writer believes that tuberculous adenitis can be cured by the use of radium, that the procedure is safe when properly carried out, and that no scar is left if suppuration has not already occurred.

His technique consists of the use of square flat applicators 2 cm. square containing 15 mg. radium bromid, or applicators twice this size, containing the same amount of radium, may be used. With this applicator the time required is twice as long. The applicator is made of silver 3 mm. thick, and the radium, mixed with some base to make it adhere, is spread on it. The applicator has over it a screen of 1 mm. of silver, over this a layer of lint, and finally 2 layers of thin gutta-percha tissue tied over the whole to prevent soiling of the screen or the radium. The gutta-percha tissue can be renewed

when the applicator is used on another patient. The gamma rays of radium are used in this work; the screen of silver absorbs the alpha and beta rays, and the secondary beta rays set up when the gamma rays emerge from the silver screen, are absorbed by the lint and gutta-percha tissue layers. The applicator is strapped to the part of the body where the tuberculous glands are, usually the neck, and left on 4-8 hours if the larger applicator is used, or half that time for the smaller one. The dose is repeated twice a week at first, and once a week when the glands are markedly subsiding.

The number of doses necessary varies; one patient recovered with only 2 applications. In general those patients with early tuberculous glands recover soonest. Treatment is continued until all signs of disease have disappeared. If a cold abscess has formed but has not ruptured, the pus should be aspirated, the skin around the perforation painted with 2% picric acid in spirit, and a small dressing applied before giving the radium treatment, repeating the process as soon as the pus accumulates again.

A possible theory for the action of the radium is that instead of a destructive dose, as used in carcinoma, a stimulating dose is given, so that the weakened tissues are enabled to combat the infecting organism.

Radium Emanation Therapy.

F. Gudzent, Klin. Wchnschr., Berlin, 1:1658, 1922.

Inasmuch as radium salts, radio-thorium, thorium x, thorium emanation and actinium all cooperate in radium emanation, it is proper to speak of these as radio-active substances. In quantities of 0.001 mg. radium equivalent, these substances increase the vital functions, in amounts of 0.25 mg. they inhibit them, and in amounts of 0.33 mg. they destroy them. The effects do not depend on the substances themselves but on their radiation.

For therapeutic purposes there are employed gaseous products, soluble salts and insoluble salts of radium, thorium and actinium. The gaseous products are administered by inhalation and by drinking liquids in which these substances are dissolved, and also through the skin. After reaching the organism they act as gases; they do not form chemical compounds. For practical purposes only radium emanation need be considered. During inhalation in a closed room the blood takes up about one-third of the amount of liberated gas. The amount absorbed by the skin is negligible. The actual emanation takes place through the lungs. The products of decomposition which are not loosely combined remain in the body for a long period and are slowly excreted by the intestines and kidneys. Soluble radio-active salts are excreted by degrees, what is not thus excreted remaining in the bone-marrow and spleen. Insoluble radio-active substances are employed in the form of radium baths and radium compresses. Inhalations are best obtained by the emanatorium. Treatment by drinking radium is combined with radium baths and inhalation through the skin. For emanation an average of 20 emans is required, with a séance lasting two hours. In all 20-24 séances are necessary. For the "water cure" an average daily dose of 20,000 emans is required; for the baths the same doses as for inhalation, and for an injection the most effective dose is a radium equivalent of 0.001 mg.

The indications for treatment with radium are: Subacute and chronic arthritis, gout, myalgia, neuralgia and some diseases of the blood. In these cases a curative effect is assured. After the use of radio-active substances there is an improvement in the local and general symptoms. In so-called chronic articular rheumatism, especially in recent affections and in young persons, improvement and arrest of the disease follow, which, however, are rarely permanent. Good results are also seen in gout with genuine tophi. Severe reactions occurring immediately after the treatment is begun, must be combated with atophan and colchicum, and eventually it will be found that great improvement will set in and the residuums from earlier attacks will disappear with remarkable rapidity. Radium treatment is not to be employed in severe cases of arthritis with extensive deposits of urates. The results in gout are frequently lasting. One or two injections of radio-active substances may be sufficient to bring about an improvement in secondary and in pernicious anemia. Radium has the effect of diminishing pain in the myalgias and neuralgias and especially in sciatica. In some individual instances good results are even seen in various chronic inflammations.

It is well known that small doses of radio-active substances improve function, stimulate blood formation, increase purin metabolism, improve purin excretion, lower blood pressure, and induce diuresis. They also increase the activity of the adrenals, and hasten cell growth and cell regeneration. They have also an anodyne effect.

Combined Radiotherapy of Rectal Cancer.

G. F. Gaarenstroom, Nederl. Tijdschr. v. Geneesk., Haarlem, 66:2165, 1922.

The writer describes 2 cases of inoperable cancer of the rectum that were treated with radium and x-rays and have remained cured for 5 and 6 years, respectively. In the first case (1915), small sacral and perineal fields were exposed and the x-rays were also admitted by means of rectal and vaginal speculums. The dose per field was 21-23 H filtered through 3-5 mm. aluminum at 20-30 cm. anticathode-skin distance. The radium, 101.5 mg. bromid, equivalent to 55 mg. element, was distributed in 5 tubes, placed at various depths in the extensive rectal tumor, filtered through 1 mm. brass and 2 mm. rubber, and left in place for 12 hours. Six roentgenotherapeutic sittings alternated with six radium treatments, the entire series occupying 20 days. According to present methods of calculation, the radium dose was about 4000 mg. hr.; the Roentgen rays were at that time quite weak.

In the second case (1917), heavy doses of hard rays were first given through 10 fields, over the abdomen, back and gluteal region. At two 12-hour sessions, radium bromid was applied, the rays from an equivalent of 55 mg. radium element being filtered through 1 mm. brass and 1 mm. rubber. At intervals of 2 months, the second and third courses of roentgenotherapy, and one radium course of 25 hours were given. Three months later the x-rays were again applied, followed in another 6 months by 10 hours' treatment with 33 mg. radium element. The total radium dosage was about 3300 mg. hr.

The favorable effects of radium and x-rays was aided by establishing an artificial anus and by improving the general condition. Few patients have the courage or tolerance for a course of treatment involving the large doses of x-ray and radium employed in these cases.

The Treatment of Chronic Rheumatism with Especial Reference to Radium.

L. L. Albert, Rhode Island M. J., 5:307, 1922.

The writer considers injections of radium in solutions of different strengths a more reliable treatment than any heretofore used. His experience has been that 0.25 mg. radium dissolved in 2 c.c. sterile salt solution gives the best result. The injection is given intravenously. If the vein cannot be located, the results are apparently the same in injecting deeply into the muscle, but the reaction is not so prompt and severe as in the case of an intravenous injection. Usually within 6-10 hours after the injection the patient feels a general malaise, with a marked increase of pain in the affected joints for a varying number of days, usually from 2 to 10. As soon as the reaction subsides, general improvement is noted in all the joints. The greater the reaction, the better the result. The dosage of radium should be large enough to cause a reaction lasting about 8 days, and should be repeated about every 2 weeks.

SECTION XI

RADIUM—EXPERIMENTAL STUDIES

Effect of Injection of Active Deposit of Radium Emanation on Rabbits.

L. Hektoen & H. J. Corper, J. Infect. Dis., 31:305, Oct., 1922.

Solutions of sodium chlorid containing active deposit were used as described by Bagg. The method of obtaining the deposit is described in detail. In brief, it consists in drawing off the radium emanation, together with the hydrogen and oxygen formed through the decomposition of water, by means of a vacuum pump, then removing the gases by suitable chemical means, and passing the purified emanation into a tube containing fused sodium chlorid. In 3 to 4 hours the maximum equilibrium amount of active deposit, consisting of radium A, B, and C, is held in the salt. The amount of this active deposit is measured by the gamma ray electroscope. Addition of sterile distilled water to the salt results in a solution containing a large proportion of active deposit. This is drawn into a syringe, and the dose measured in millicuries, by comparing the syringe full and after injection with a known preparation of radium, again using the gamma ray electroscope.

In order to study the leukotoxic action and changes produced in the rabbits by the active deposit, graded intravenous injections were given a series of animals; total and differential leukocyte counts were made before and at regular intervals after injection, and if the animal died the tissues were studied. It was found that the active deposit was lethal to rabbits when given intravenously in amounts approximately

8-10 mc. per kilo. of weight. In such doses, there was an initial leukocytosis, and a final leukopenia, mainly of the polymorphonuclear cells. Non-lethal doses produced no constant effect. Lethal doses were associated pathologically with congestion and small hemorrhages in the lungs, liver, lymph-glands, spleen, suprarenals and kidneys and with a loss of cells in the bone-marrow.

To determine the effect of active deposit on anti-body formation, rabbits were injected with 1, 5, and 10 mc., four days before, coincident with, or five days after intraperitoneal injection of 10 c.c. of citrated sheep blood per kilo. of weight, and the specific precipitin and lysin for sheep blood were determined at regular intervals. It was seen that this may cause a depression in the formation of specific lysin, and to a less extent of precipitin for sheep blood.

SECTION XII

RADIUM—APPARATUS

A New Method of Applying Radium Through the Cystoscope.

L. Buerger, New York State J. Med., 22:312, 1922.

Of radium needles, two sizes and types are recommended, steel needles containing 20 mg. each, and a hollow platinum needle enclosing approximately 50 mg. of the radium salt. These have been especially constructed and are of minimum length, so as to be easily introduced either by means of an attachable wire stem or a special spiral applicator. The needles are composed of two parts, the needle point with shaft and a detachable eye. This arrangement permits of two methods of introduction, either with a wire shank or a spiral applicator. The needle point is short and is an integral part of the radium chamber, its proximal end being provided with a female screw thread. This may receive either the eye end, or the male portion of a wire applicator. Thus, such a needle may be introduced into a growth either with an attached wire shank or as a complete needle whose eye receives a fine wire retainer.

Two types of introducer or applicator have been found useful. One is a spiral flexible wire shank with a metallic cup for the reception of the eye end of the radium needle, and with its proximal end fitted with a metallic enlargement for the adaptation of the rubber catheter or nipple. The metallic cup is an incomplete cylinder having a longitudinal slot or an aperture through which a holding wire may slip or emerge. The needle is threaded with fine wire doubled on itself and long enough to emerge 14 inches beyond the catheter outlet. Less rigid, finer wire, twisted after being threaded, may be found useful. The needles may be subsequently withdrawn by means of this holding wire. Just before insertion in the cystoscope, the needle, with wire thread, is placed in the metallic cup. The wire emerges through the slot or aperture and passes alongside of the spiral shank and through the rubber nipple at the catheter outlet. A slight pull on this wire suffices to retain the needle in its socket, or the retaining wire may be fastened to the spiral by an appropriate screw clamp. When this variety of applicator is employed,

the aim is to withdraw it, leaving the needle with the wire in situ, the cystoscope being then removed. A second type of applicator is intended for those who may find some difficulty in mastering the technique of withdrawing the spiral applicator. This consists of a flexible spiral with male thread to fit into the female receptacle of the needle, the eye of which must be removed before attachment is made.

Although this type may appear easiest to employ, particularly as far as withdrawal of the cystoscope is concerned, it carries with it the disadvantage that a heavier stem must be retained in the urethra. This may be objectionable in the male, in that movement of the pendulous urethra tends to displace the needle. A third applicator is patterned after the first, differing only in the size of its socket or cup, this being designed to carry one 50 mg. needle of radium. For those who prefer the simultaneous introduction of two 20 mg. needles, a special applicator with a broader receptacle carrying 2 needles in team fashion may be found useful. For the introduction of radium emanations, a long flexible spiral wire applicator is recommended. Its distal end is a hollow needle into which the capillary-glass emanation tube is buried. Throughout its length travels a wire mandrin that enables the operator to plunge the radium into the growth. Ordinarily the author's operating cystoscope would be found adequate, both for the insertion of radium emanations through a special applicator, and for the introduction of one only of the special steel and platinum needles above described. Under certain conditions, however, he has found the direct type of cystoscope, or one with an oblique vision, preferable.

SECTION XIII

RADIUM—DANGERS OF—INJURIOUS EFFECTS

Accidents Consecutive to Treatment of Uterine Fibromas by Radium:

E. Godlewski, Bull. Soc. d'obst. et de gynec. de Paris, 10:672, No. 8, 1921.

Applications of radium may be followed by unfavorable symptoms of two classes. The first are due to a previous infection of the patient, faulty aseptic methods, or retention of septic products; infectious complications of this sort can in a measure be prevented by improvement in operative technique.

The other class of accidents seem on the other hand frequently impossible to avoid. To illustrate these complications five cases are mentioned. In three fever and hemorrhage appeared towards the tenth day. In the other two phlebitis appeared during the third week.

These accidents correspond to the sloughing away of eschars and arise from the special action of radium on the tissues. It is impossible at the present time to say whether they are due principally to the dose, to the time of exposure or to the susceptibility of the tissues.

Radiotoxemia; Its Cause and Suggestions for its Prevention.

E. G. Beck, J. Radiol., 3:301, August, 1922.

It has long been known that illness may follow the application of

radio-active substances or X-rays, the severity depending on the dosage. The principal symptoms are lassitude, dizziness, palpitation, nausea and cold sweats, even in some cases with fatal results. These symptoms appear usually within 24 hours and persist for 3-4 days, then gradually subside. They reappear after subsequent dosage. As they resemble the symptoms of other types of toxemia, especially those associated with the late stages of cancer, it is important to determine which form of toxemia causes them, and a simple test is that if the patient is suffering from radiotoxemia he almost certainly quickly improves.

The rays are not the actual toxic agents; it is their action upon the cellular structures that produces the toxic products. What form of change will take place is dependent upon the size of the dosage and the radio-sensitiveness of the cell itself. But the end-products of cellular or fibrous tissue destruction are highly toxic, and since they are absorbed into the circulation before they can be eliminated they produce the toxic symptoms described. It is not in the superficial growths but in deep-seated growths of large size, such as tumors of the lungs and liver, or in Hodgkin's disease, that the great danger lies, because the dosage required is so heavy and the amount of toxic material produced by the breaking down of the cellular tissue and thrown into the circulation is so large that elimination cannot keep pace with it.

Prevention of Toxemia.

The writer's plan of prevention is by radical surgery to expose the tumor and remove as much of it as is consistent with safety, and then leave the wound open, no matter how large it may be, so as to be able to give direct application of the radio-active agent into the cancer bed. The surgical procedure is to remove the skin, the fat and the muscles and as much of the tumor as is safe or possible. This sometimes leaves a perfectly clean field and no visible remains of the growth, at other times it is possible only to remove part of the growth because it is attached to or imbedded in vital organs. Allowing this large area to remain widely open the X-rays or radium may be applied directly into the bed of the disease. Screening is only necessary when there are large blood-vessels, vital organs or nerves in close proximity to the open wound. The danger of skin burns is also eliminated. The dosage of radiation may be reduced to one-tenth the quantity which would be required if the applications were made through the skin.

The reasons why the toxemia should not appear when this form of treatment is employed are: (1) The greater part if not all of the growth can usually be removed by surgery, which in itself takes away one of the main sources of the toxic products. (2) In treating this open field not nearly the dosage is needed which would be required if the overlying tissues, sometimes 3-4 inches thick, were covering the tumor masses. (3) Whatever decomposition takes place as a result of radiation in the crater of the wound is now drained into the dressings instead of being taken up into the circulation. In over 100 cases of advanced or recurrent cancer thus treated during the past two years there were no fatalities from toxemia, while during the three years preceding four patients succumbed to toxic symptoms.



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